

Comparison of Airborne Sunphotometer to MODIS and MISR Retrievals of Aerosol Optical Depth during MILAGRO/INTEX-B

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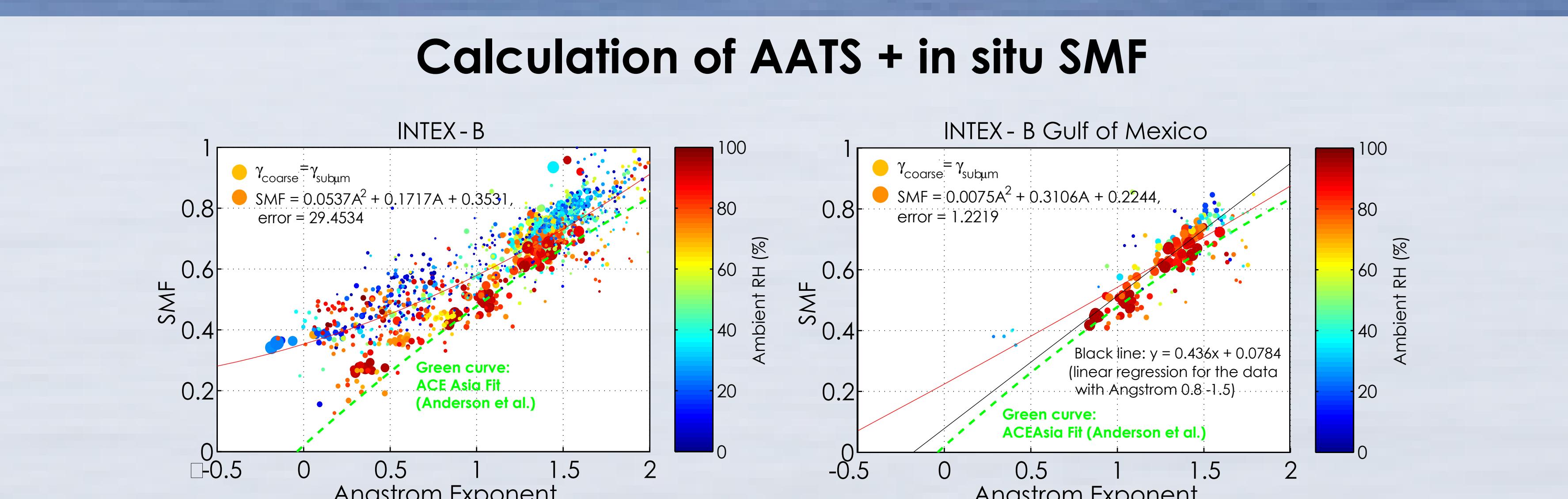
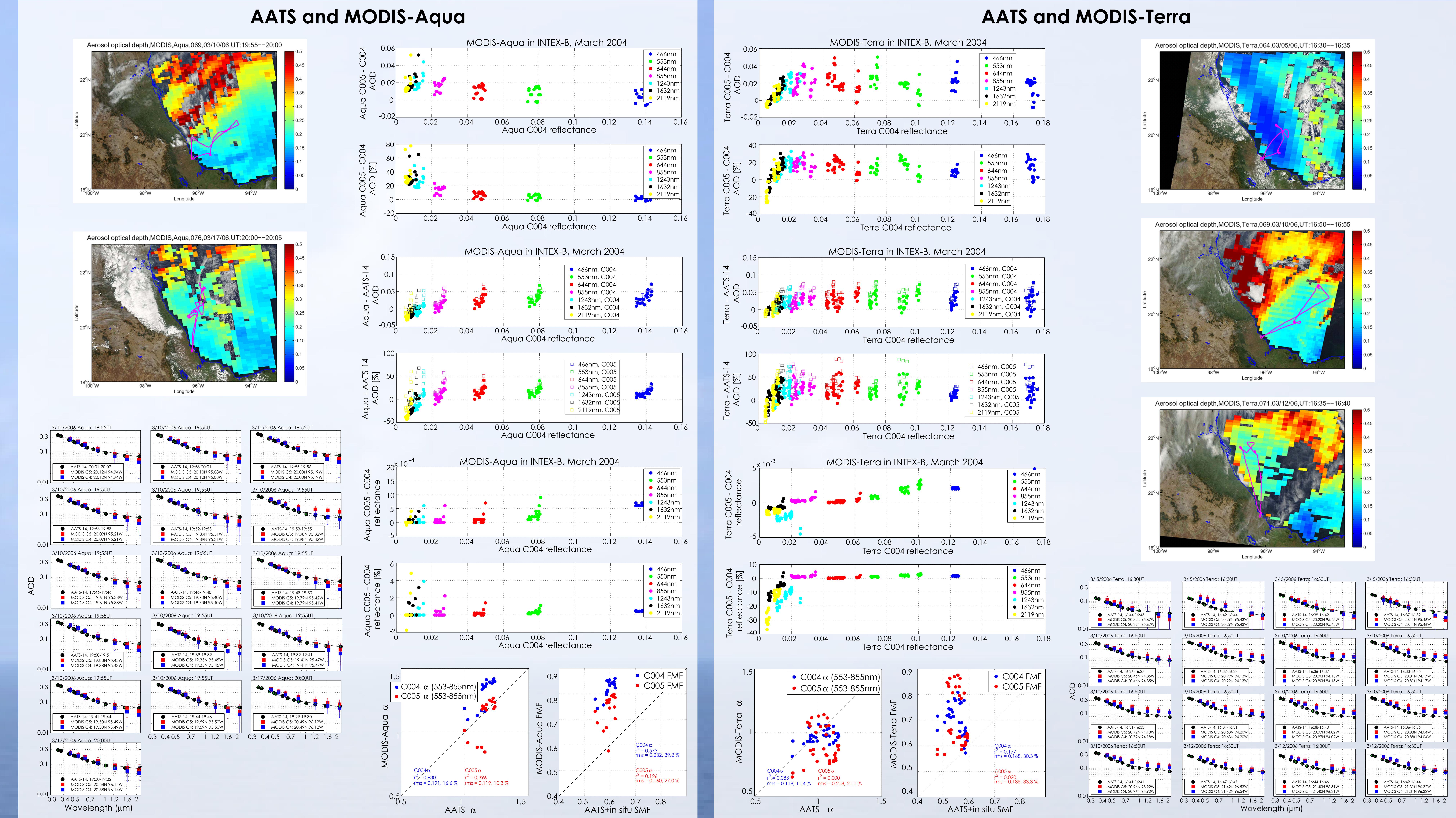
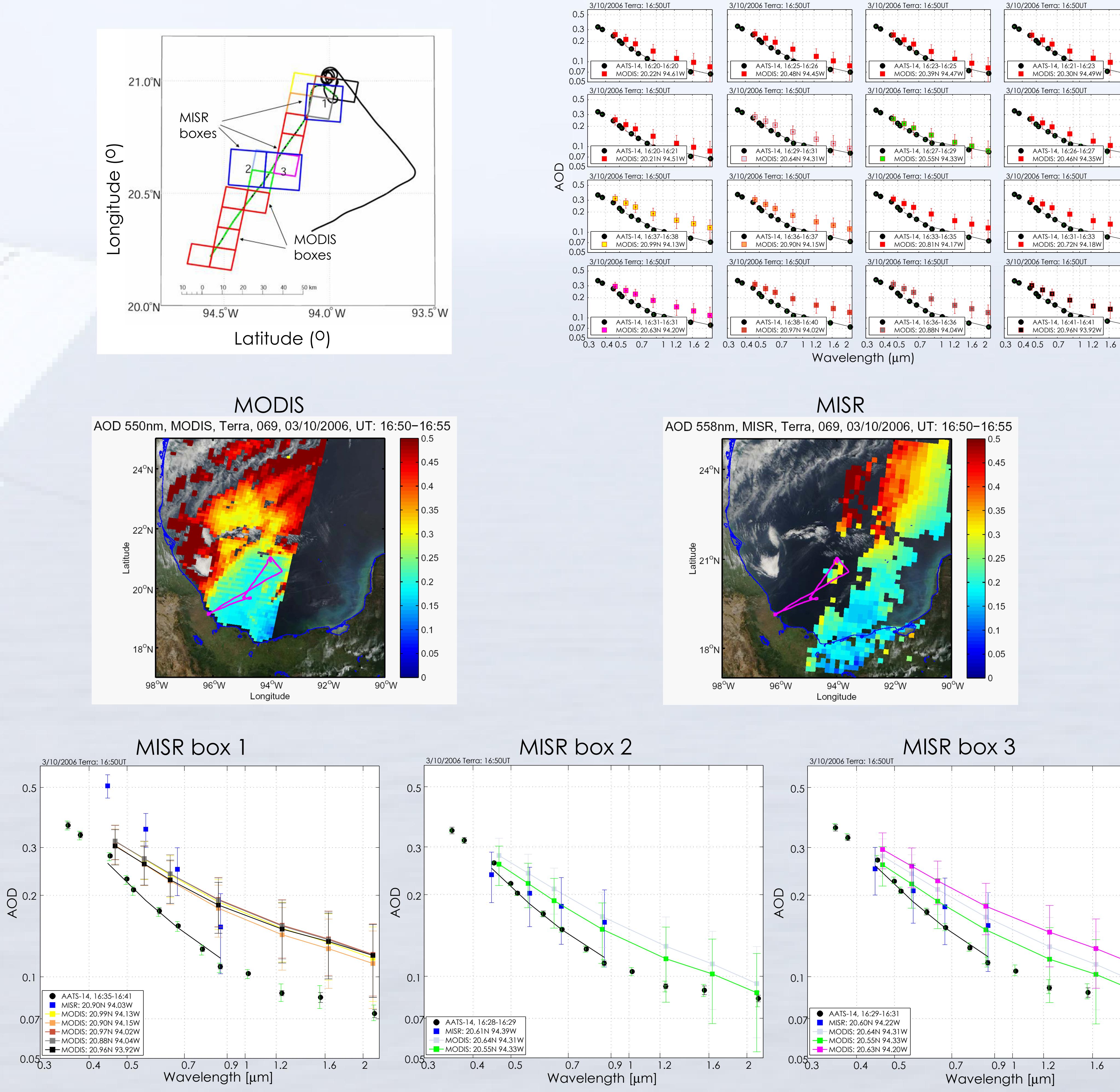
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ABSTRACT

The 14-channel Ames Airborne Tracking Sunphotometer (AATS-14) was operated on a Jetstream 31 (J31) aircraft based in Veracruz, Mexico in March 2006 during MILAGRO/INTEX-B (Megacity Initiative-Local And Global Research Observations /Phase B of the Intercontinental Chemical Transport Experiment). AATS measured aerosol optical depth (AOD) at 13 wavelengths (354–2139 nm) and water vapor column content in 13 flights that sampled clean and polluted airmasses over the Gulf of Mexico and Mexico City. J31 flights were coordinated with overflights of several satellites, including Aqua, Aura, Terra, and Parasol. In this paper we will focus on comparing AATS retrievals of AOD with corresponding AOD values retrieved from spatially and temporally coincident or near-coincident measurements acquired by the satellite sensors MODIS (Aqua and Terra), and MISR (Terra).

Detailed comparisons between AATS, MODIS-Terra and MISR on March 10, 2006

Here we provide preliminary analysis of the collocated measurements by AATS, MODIS-Terra and MISR over the Gulf of Mexico on March 10, 2006. For the low-level J31 flight track shown in the map, there are currently three collocated MISR aerosol retrievals produced by the operational MISR algorithm version 19. In two of the three retrieval boxes the MISR mid-visible AOD (at 446 and 558 nm) compares well with both the collocated AATS and MODIS-Terra observations, while the MISR AOD retrievals in the third box are greater than those produced by either AATS or MODIS. The MISR near-IR AOD retrievals agree both with AATS and MODIS-Terra within measurement uncertainty. The Angstrom exponents derived by MISR in boxes 1 and 2 are smaller than those measured by AATS, while the MISR Angstrom exponent in the third box is similar to the AATS value.



The MODIS derived fine mode fraction (FMF) yields an indication of anthropogenic fraction of atmospheric aerosols. To test the MODIS retrievals of FMF, we use a combination of in situ and airborne sunphotometer (AATS) data. First, we use the in situ data to establish a relationship between the submicron fraction of aerosol extinction (SMF) and the spectral dependence (as quantified by the Angstrom exponent) of aerosol extinction at ambient conditions. The data and regression of this relationship are shown in the figure above for all INTEX-B data and for data over the Gulf of Mexico, respectively. We then apply the quadratic expression for SMF as a function of Angstrom exponent to the sunphotometer-derived Angstrom exponent, yielding a full-column estimate of SMF. Finally, we plot the MODIS-derived FMF versus the "AATS + in situ" SMF thus derived.

SUMMARY and CONCLUSIONS

Our preliminary analyses of 37 coincident observations by AATS and MODIS-Terra and 18 coincident observations between AATS and MODIS-Aqua indicate notable differences between MODIS Collection 004 and Collection 005, the latter representing a reprocessing of the entire MODIS data set completed during 2006. For example, our analyses show that for MODIS Collection 004, 81.9% of spectral MODIS-Terra AOD retrievals fall within the estimated uncertainty range of $\pm 0.03 \pm 0.5 \text{ AOD}$, while 90.5% of MODIS-Aqua AOD retrievals fall within this uncertainty range. By contrast, in Collection 005, these values drop to 50.5% and 78.6%, respectively. Investigating the 10km-averaged reflectances that serve as input to the MODIS aerosol retrievals, we find that the changes in the AOD retrievals for MODIS-Terra are directly traceable to changes in the input reflectances between Collection 004 and Collection 005. These changes are much more pronounced for MODIS-Terra than for MODIS-Aqua.

As far as MODIS retrievals of Angstrom exponent and FMF are concerned, the step from Collection 004 to Collection 005 results in better agreement with the suborbital observations. For MODIS-Terra no analogous improvement in the agreement with suborbital observations is found in going from Collection 004 to 005.

Collocated measurements by AATS, MODIS-Terra and MISR within three MISR retrieval grid cells over the Gulf of Mexico on March 10 have been analyzed. Mid-visible (at 446 and 558 nm) AOD retrievals produced by the MISR standard operational algorithm Version 19 compare well both with AATS and with MODIS-Terra observations in two of the three MISR grid cells, while the MISR AOD retrievals in the third cell exceed those obtained from AATS or MODIS. MISR near-IR (866nm) AOD retrievals agree with corresponding AATS and MODIS-Terra retrievals within measurement uncertainty.